

REMARKS

By this amendment, claim 37 has been cancelled and claims 5, 27, 29, 35, and 41 have been amended. Accordingly, claims 5-27, 29-36, and 38-44 are pending in the present application. The claim amendments are supported by the specification, the accompanying figures, and claims as originally filed, with no new matter being added. Accordingly, favorable reconsideration of the pending claims is respectfully requested.

1. Rejections Under 35 U.S.C. §102

Claims 25 and 41-44 have been rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,287,980 to Hanazaki et al. (hereinafter (“*Hanazaki*”)) for the reasons set forth on pages 2-3 of the Office Action. Applicants respectfully traverse.

Present claim 41 recites, *inter alia*, “pulsing into said etch chamber a carbon containing polymer gas suitable for: forming a deposit on at least a portion of said microelectronics substrate; and etching said microelectronics substrate; wherein said pulsing imparts a time varying flow rate to said gas for a plurality of periods of said time varying flow rate, thereby causing said gas to alternately form a deposit on at least a portion of said microelectronics substrate and etch said microelectronics substrate.”

*Hanazaki* has no such disclosure. Rather, *Hanazaki* discloses alternately pulsating etchant gasses ( $\text{Cl}_2$  and  $\text{BCl}_3$ ) and a sedimentary gas ( $\text{CHF}_3$  or other flon substances). See *Hanazaki* at column 18, line 8; column 25, lines 8-18; and column 26, lines 17-31. Further, *Hanazaki* does not disclose the use of  $\text{CHF}_3$  or any other carbon containing polymer gas for use as an etchant, and does not disclose the use of a carbon containing polymer gas to both etch and form a deposit.

Claims 25 and 42-44 depend from claim 41 and include the limitations therein. Accordingly,

Applicants therefore respectfully assert that *Hanazaki* does not anticipate claims 25 and 41-44 under 35 U.S.C. § 102(e), and the prompt removal of this rejection is therefore respectfully requested.

2. Rejections Under 35 U.S.C. §103

Claims 5-9, 11-12, 15, 17-22, 24, 26, and 39 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hanazaki* in view of U.S. Patent No. 5,368,685 to Kumihashi et al. (“*Kumihashi*”) for the reasons set forth on pages 3-6 of the Office Action. Applicants respectfully traverse.

Independent claim 5 recites, *inter alia*:

wherein the pulsing provides for the alternating steps of:  
    etching said microelectronics substrate with said at least one  
    gas; and

    forming a deposit with said at least one gas on a vertical  
    surface of the microelectronics substrate, the deposit preventing  
    additional etching of the vertical surface of said microelectronics  
    substrate underneath the deposit.

Accordingly, the invention as recited in present claim 5 is directed to the pulsing of at least one gas to provide for the alternate steps of etching and forming a deposit that prevents additional etching. It does not recite alternately pulsing different gasses, one of which etches and the other forms a deposit.

*Hanazaki*, in contrast, discloses alternately pulsating two sets of “at least one gas”: a pair of etchant gasses ( $\text{Cl}_2$  and  $\text{BCl}_3$ ) and a sedimentary gas ( $\text{CHF}_3$  or other flon substances). See *Hanazaki* at column 18, line 8; column 25, lines 8-18; and column 26, lines 17-31.

Applicants therefore respectfully assert that claim 5 is patentable over *Hanazaki*. Claims 6-9, 11-12, 15, 17-22, 24 and 26 depend from claim 5, include the limitations therein, and are therefore also patentable over *Hanazaki* for at least the foregoing reasons discussed with respect to claim 5.

In addition, with regard to claim 9, *Hanazaki* teaches pulsing wherein the concentration

within the etch chamber reaches steady state at least once in a give plurality of periods. See *Hanazaki*, Figures 13A. This steady state period is depicted as the period of time when the pulse is level either at its maximum or minimum.

In contrast, Figures 12A and 12B of the present application illustrate non-steady state pulsing. As stated in the specification in the paragraph beginning at page 25, line 21:

The solid lines in Figs. 12A and 12B do not superimpose with the respective dashed lines. This feature indicates that under these pulsing conditions the medium within the chamber does not reach steady state conditions. As shown by the solid lines in Figs. 12A and 12B, the transition time between state 1 and state 2 conditions is a significant fraction of the period, and the chamber operates under non steady state conditions for approximately all the time. Figures 12A and 12B illustrate an example of fast pulsing conditions in an embodiment of the present invention in which the system does not reach steady state conditions for any of the states 1 or 2.

Therefore, a careful readying of present claim 9 reveals what is taught in the specification, that the pulsing recited in claim 9 operates so that the gas does not reach steady state conditions since “the chamber operates under non steady state conditions for approximately all the time.” *Id.* Thus, the limitation of claim 9 regarding non-steady state conditions is not taught or suggested by *Hanazaki*, and the prompt removal of the rejection of claim 9 is therefore respectfully requested.

Claims 10, 13, 14, and 16 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hanazaki* in view of *Kumihashi* for the reasons set forth on pages 6-7 of the Office Action. Applicants respectfully traverse.

The limitations of present claim 5, as discussed hereinabove, are not taught or suggested by *Hanazaki* in view of *Kumihashi*. Claims 10, 13, 14, and 16 depend from claim 5 and include the limitations thereof. Therefore, claims 10, 13, 14, and 16 are patentable over *Hanazaki* in view of *Kumihashi* for at least the reasons presented hereinabove with respect to claim 5.

Claims 27, 29, and 30 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hanazaki* in view of U.S. Patent No. 5,439,978 to Lu et al. (hereinafter “*Lu*”) for the reasons set forth on pages 7-8 of the Office Action. Applicants respectfully traverse.

Present claim 27 recites the use of two gasses: a pulsed fluorocarbon gas and a hydrofluorocarbon gas. Neither of *Hanazaki* and *Lu* disclose such a feature of the invention. *Hanazaki*, for example, discloses the use of only one of a fluorocarbon gas and a hydrofluorocarbon gas, and provides no motivation or suggestion to use more than one. *See Hanazaki* at column 26, lines 16-31. Claims 29 and 30 depend from claim 27 and include the limitations therein. Therefore, claims 27, 29, and 30 are patentable over *Kumihashi* in view of *Lu* for at least the foregoing reasons.

Claims 31-34 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hanazaki* for the reasons set forth on pages 8-9 of the Office Action. Applicants respectfully traverse.

Present claim 31 recites “pulsing into said etch chamber at least one gas suitable for forming a deposit . . . wherein . . . said at least one gas comprises a gas selected from the group consisting of a halogenated hydrocarbon and a fluorocarbon” and “etching said microelectronics substrate with a second gas . . . wherein . . . said second gas is selected from the group consisting of a polymer forming gas, a polymer etching gas, and a fluorocarbon.” As previously mentioned, *Hanazaki* has no such teaching and discloses instead alternately pulsing a flon gas with Cl<sub>2</sub> and BCl<sub>3</sub> etching gasses. Applicants therefore respectfully assert that claim 31 is patentable over *Hanazaki*. Claims 32-34 depend from claim 31, include the limitations therein, and are therefore patentable for at least the foregoing reasons discussed with respect to claim 31.

In addition, with regard to claim 33, *Hanazaki* teaches pulsing wherein the concentration within the etch chamber reaches steady state at least once in a given plurality of periods. *See*

*Hanazaki*, Figures 13A. This steady state period is depicted as the period of time when the pulse is level either at its maximum or minimum.

In contrast, Figures 12A and 12B of the present application illustrate non-steady state pulsing.

As stated in the specification in the paragraph beginning at page 25, line 21:

The solid lines in Figs. 12A and 12B do not superimpose with the respective dashed lines. This feature indicates that under these pulsing conditions the medium within the chamber does not reach steady state conditions. As shown by the solid lines in Figs. 12A and 12B, the transition time between state 1 and state 2 conditions is a significant fraction of the period, and the chamber operates under non steady state conditions for approximately all the time. Figures 12A and 12B illustrate an example of fast pulsing conditions in an embodiment of the present invention in which the system does not reach steady state conditions for any of the states 1 or 2.

Therefore, a careful readying of present claim 33 reveals what is taught in the specification, that the pulsing recited in claim 33 operates so that the gas does not reach steady state conditions since “the chamber operates under non steady state conditions for approximately all the time.” *Id.* Thus, the limitation of claim 33 regarding non-steady state conditions is not taught or suggested by *Hanazaki*, and the prompt removal of the rejection of claim 9 is therefore respectfully requested.

Claims 23, 35-38, and 40 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hanazaki* in view of U.S. Patent No. 5,933,759 to Nguyen et al. (“*Nguyen*”) for the reasons set forth on pages 9-10 of the Office Action. Applicants respectfully traverse.

Present claim 35 recites, *inter alia*, “at least one of said gases comprises an etchant gas selected from the group consisting of a hydrofluorocarbon and a fluorocarbon; and at least one of said gases comprises a polymer forming gas for depositing a protective layer.” As previously mentioned, *Hanazaki* has no such teaching. Applicants therefore respectfully assert that claim 35 is patentable over *Hanazaki*. Claims 36-38 and 40 depend from claim 31, include the limitations

therein, and are therefore patentable for at least the foregoing reasons discussed with respect to claim 35. Claim 23 depends from claim 5, includes the limitations therein, and is therefore patentable for at least the reasons discussed hereinabove with respect to claim 5.

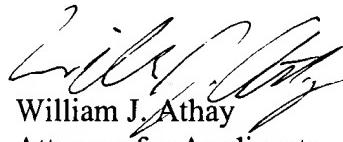
Accordingly, for each of the foregoing reasons, Applicants respectfully assert that claims 5-27, 29-36, and 38-44 are patentable over the cited references. Applicants therefore request that the rejection of these claims under 35 U.S.C. § 103(a) be promptly removed.

CONCLUSION

In view of the foregoing, Applicants respectfully request favorable reconsideration and allowance of the present claims. In the event the Examiner finds any remaining impediment to the prompt allowance of this application that could be clarified by a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney.

Dated this 11th day of October 2002.

Respectfully submitted,

  
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**VERSION WITH MARKINGS SHOWING THE CHANGES MADE**

**In the claims:**

Claims 27, 29, 35, and 41 have been amended as follows:

27. (Twice Amended) A method of etching oxide using a polymer, the method comprising:

disposing a patterned semiconductor substrate in a high density plasma etcher, said substrate comprising a silicon layer with a gate stack structure disposed thereon, said gate stack structure being encapsulated by silicon nitride, and layered with an oxide;

providing a hydrofluorcarbon gas into said high density etcher;

selectively removing portions of said oxide by pulsing a fluorocarbon gas; wherein:

    said pulsing imparts a time varying flow rate to said fluorocarbon gas for a plurality of periods of said time varying flow rate; and

    said fluorocarbon gas forms a protective layer; and

    [providing a hydrofluorcarbon gas, ]

wherein the pulsing of said fluorocarbon gas causes said hydrofluorcarbon gas to have cyclical concentrations within said high density etcher.

29. (Twice Amended) The method as defined in Claim 27, wherein said hydrofluorcarbon gas is pulsed into said high density etcher so that the hydrofluorcarbon gas pulses alternate with the fluorocarbon gas pulses and wherein pulsing said hydrofluorcarbon gas imparts a time varying flow rate to said hydrofluorcarbon gas for a plurality of periods of said time varying flow rate.

35. (Twice Amended) An etching method comprising:

    exposing a substrate to a plurality of gases, wherein at least one of said gases is pulsed and said pulsing imparts a time varying flow rate to said at least one gas for a plurality of periods of said time varying flow rate; and wherein

        at least one of said gases comprises an etchant gas selected from the group consisting of a hydrofluorcarbon and a fluorocarbon; and

        at least one of said gases comprises a polymer forming gas for depositing a protective layer.

41. (Once Amended) A method to control etch profile while etching a microelectronics substrate, the method comprising:

    providing an etch chamber and a microelectronics substrate disposed therein; pulsing into said etch chamber a carbon containing polymer gas suitable for:

        forming a deposit on at least a portion of said microelectronics substrate; and  
        etching said microelectronics substrate;

    wherein said pulsing imparts a time varying flow rate to said gas for a plurality of periods of said time varying flow rate, thereby causing said gas to alternately form a deposit on at least a portion of said microelectronics substrate and etch said microelectronics substrate.